WAA-360
5

(19) JAPANESE PATENT OFFICE
(12) PATENT JOURNAL (A)
(11) KOKAI PATENT NO. HEI 10[1998]-132796

(51) Int. Cl.[6]: G 01 N 30/24
30/86

(21) Application No.: HEI 8[1996]-307262

(22) Application Date: November 1, 1996

(43) Publication Date: May 22, 1998

No. of Inventions: 1 (Total of 4 pages; FD)

Examination Request: Not requested

(54) Title: LIQUID CHROMATOGRAPH AUTOINJECTOR

(72) Inventor: Nobuyuki Tatsumi
Sanjo Plant
Shimadzu Corp.
1 Nishinokyokuwabara
Chukyo-ku, Kyoto
Kyoto

(71) Applicant: 000001993
Shimadzu Corp.
1 Nishinokyokuwabara
Chukyo-ku, Kyoto
Kyoto

(74) Agent: Shigeo Noguchi, patent attorney

[There are no amendments to this patent application.]

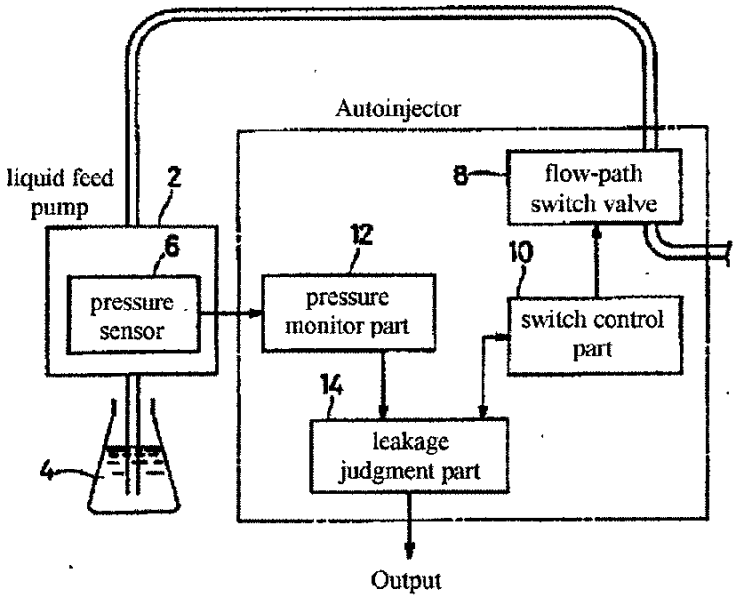
(57) Abstract

Task

To realize fluid-leakage monitoring and fluid-leakage site detection without the installation of new pressure sensors.

Means for solution

An autoinjector is fitted with a pressure monitor part (12), for input of the output from the pressure sensor (6) of fluid feed pump (2), and a fluid-leakage judgment part (14) that detects fluid leakage and the site in the flow path according to the flow-path switch valve state (8) controlled by switch control part (10) and pressure from the pressure monitor part (12).



Claim

Autoinjector characterized by being fitted with a pressure monitor part monitoring the output from the pressure sensor and a fluid-leakage judgment part that detects fluid leakage and the site in the flow path according to the flow-path switch valve state controlled by the switch control part and pressure from the pressure monitor part, in a liquid chromatograph autoinjector fitted with a flow-path switch valve for sample inlet to the flow path through which the mobile-phase solvent is fed to the column by a pressure-sensor-fitted liquid feed pump and a switch control part that controls the operation of the flow-path switch valve.

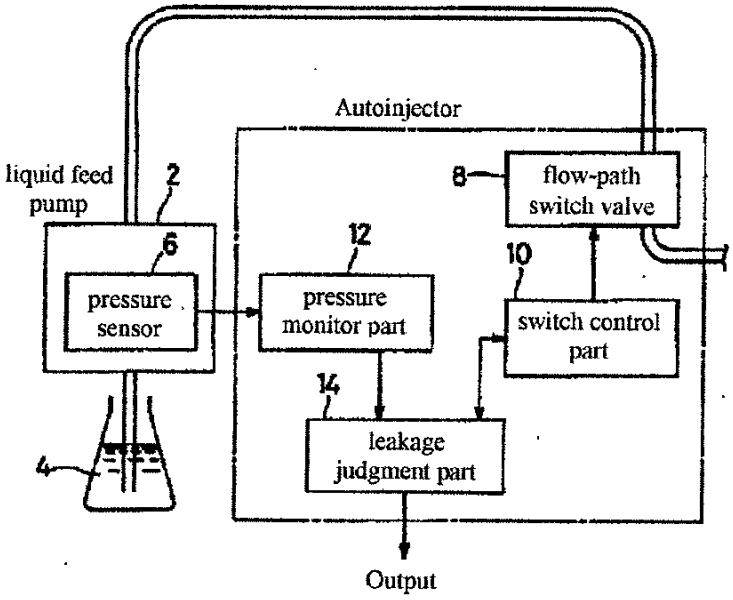
(57) Abstract

Task

To realize fluid-leakage monitoring and fluid-leakage site detection without the installation of new pressure sensors.

Means for solution

An autoinjector is fitted with a pressure monitor part (12), for input of the output from the pressure sensor (6) of fluid feed pump (2), and a fluid-leakage judgment part (14) that detects fluid leakage and the site in the flow path according to the flow-path switch valve state (8) controlled by switch control part (10) and pressure from the pressure monitor part (12).



Claim

Autoinjector characterized by being fitted with a pressure monitor part monitoring the output from the pressure sensor and a fluid-leakage judgment part that detects fluid leakage and the site in the flow path according to the flow-path switch valve state controlled by the switch control part and pressure from the pressure monitor part, in a liquid chromatograph autoinjector fitted with a flow-path switch valve for sample inlet to the flow path through which the mobile-phase solvent is fed to the column by a pressure-sensor-fitted liquid feed pump and a switch control part that controls the operation of the flow-path switch valve.

Detailed explanation of the invention

[0001]

Technological field of the invention

The present invention concerns a liquid chromatograph autoinjector fitted with a pressure monitor part for input of the output from the pressure sensor of the fluid feed pump and a fluid-leakage judgment part that detects fluid leakage and the site in the flow path according to the flow-path switch valve state controlled by switch control part and pressure from the pressure monitor part.

[0002]

Conventional technology

In a liquid chromatograph fitted with an autoinjector, the output from the pressure sensor installed in the feed pump is fed to a system controller that controls the entire liquid chromatograph or a separate personal computer for data processing, and the entire system is monitored. By monitoring the pressure by the pressure sensor in the fluid feed pump, when a greater than normal pressure drop occurs, it is judged that fluid leakage is occurring somewhere in the flow path.

[0003]

Problems to be solved by the invention

The pressure monitoring by the system controller or personal computer concerns the entire flow path. Thus, when a pressure drop occurs, indicating fluid leakage, the specific leakage site cannot be located in the flow path covering the area from the feed pump to the column via the autoinjector flow switch valve. Therefore, it is an objective of the present invention to realize not only the fluid leakage monitoring, but also to find the specific leakage site, without installing a new pressure sensor.

[0004]

Means for solving the problems

The present invention is schematically illustrated in Figure 1. The feed pump (2) sends mobile-phase solvent (4) to the column, and a pressure sensor (6) is installed on the feed pump (2). An autoinjector switch valve (8) is installed on the mobile-phase flow path between the feed pump (2) and the column, with the flow switch valve (8) being controlled by the switch control part (10), for automatic switching of the flow path in sample injection.

[0005]

In the present invention, an autoinjector is fitted with a pressure monitor part (12) for input of the output from the pressure sensor (6) of fluid feed pump (2) and a fluid-leakage judgment part (14) that detects fluid leakage and the site in the flow path according to the state of the flow-path switch valve (8) controlled by switch control part (10) and pressure from the

Detailed explanation of the invention

[0001]

Technological field of the invention

The present invention concerns a liquid chromatograph autoinjector fitted with a pressure monitor part for input of the output from the pressure sensor of the fluid feed pump and a fluid-leakage judgment part that detects fluid leakage and the site in the flow path according to the flow-path switch valve state controlled by switch control part and pressure from the pressure monitor part.

[0002]

Conventional technology

In a liquid chromatograph fitted with an autoinjector, the output from the pressure sensor installed in the feed pump is fed to a system controller that controls the entire liquid chromatograph or a separate personal computer for data processing, and the entire system is monitored. By monitoring the pressure by the pressure sensor in the fluid feed pump, when a greater than normal pressure drop occurs, it is judged that fluid leakage is occurring somewhere in the flow path.

[0003]

Problems to be solved by the invention

The pressure monitoring by the system controller or personal computer concerns the entire flow path. Thus, when a pressure drop occurs, indicating fluid leakage, the specific leakage site cannot be located in the flow path covering the area from the feed pump to the column via the autoinjector flow switch valve. Therefore, it is an objective of the present invention to realize not only the fluid leakage monitoring, but also to find the specific leakage site, without installing a new pressure sensor.

[0004]

Means for solving the problems

The present invention is schematically illustrated in Figure 1. The feed pump (2) sends mobile-phase solvent (4) to the column, and a pressure sensor (6) is installed on the feed pump (2). An autoinjector switch valve (8) is installed on the mobile-phase flow path between the feed pump (2) and the column, with the flow switch valve (8) being controlled by the switch control part (10), for automatic switching of the flow path in sample injection.

[0005]

In the present invention, an autoinjector is fitted with a pressure monitor part (12) for input of the output from the pressure sensor (6) of fluid feed pump (2) and a fluid-leakage judgment part (14) that detects fluid leakage and the site in the flow path according to the state of the flow-path switch valve (8) controlled by switch control part (10) and pressure from the

pressure monitor part (12). The pressure monitor (12) takes the pressure sensor (6) output with A/D conversion, with the leakage judgment part (14) detecting the flow-path switch valve (8) rotation according to the output of the switch control part (10).

[0006]

When the flow-path switch valve (8) is switched by the autosampler operation, if the pressure drop is substantial enough for indicating leakage, leakage can be judged to have occurred in the injector part (8). On the other hand, if the pressure drop is substantial enough for indicating leakage when the flow-path switch valve (8) is not switched, the leakage can be judged to have occurred somewhere upstream with respect to the flow-path switch valve (8). When the pressure drop was substantial enough for indicating leakage when the flow-path switch valve (8) is switched after replacing the rotor seal of the flow-path switch valve (8), it can be judged that the rotor seal replacement was not done correctly.

[0007]

Application Example

Figure 2 illustrates an application example. A flow-path switch valve (8) is installed on the flow path (22) for feeding the mobile phase (4) to the column (20) by the feed pump (2). By switching the flow-path switch valve (8) of the autoinjector, the sample is introduced into the mobile-phase flow path (22). A detector (24) is installed downstream from the column (20), and the mobile phase is discharged through the detector (24).

[0008]

In the autoinjector, the flow path is switched by rotation of the flow-path switch valve (8) by the motor (26). The autoinjector control part (18) consists of a motor driver part (10a) controlled by the switch control part (10) for control of flow-path switching, A/D converter (30) for A/D conversion of the output of pressure sensor (6) in the feed pump, and a CPU (32) for control of not only activation of sample introduction by switching the flow path by the flow-path switch valve (8), but also leakage detection due to monitoring by the pressure sensor (6), and specifying the leakage site in relation to flow-path switching by the motor driver part (10a). The pressure monitor (12) leakage judgment part (14) in Figure 1 is realized by CPU (32) in Figure 2.

[0009]

Next, the operation of leakage detection and specifying the leak site in this example is explained with Figures 3 and 4. Figure 3 shows the operation for leakage detection in ordinary analysis. At the onset of analysis, CPU (32) conducts the input of pressure data from the output of pressure sensor (6) via A/D converter (30). In the absence of a drop in excess of a designated value, the pressure is considered normal, and the operation is continued. If the pressure drop is more than the designated value, leakage is judged. When leakage is judged, rotation of the flow-path switch valve (8) is checked by the output of motor driver (10a). If rotation of the flow-path

pressure monitor part (12). The pressure monitor (12) takes the pressure sensor (6) output with A/D conversion, with the leakage judgment part (14) detecting the flow-path switch valve (8) rotation according to the output of the switch control part (10).

[0006]

When the flow-path switch valve (8) is switched by the autosampler operation, if the pressure drop is substantial enough for indicating leakage, leakage can be judged to have occurred in the injector part (8). On the other hand, if the pressure drop is substantial enough for indicating leakage when the flow-path switch valve (8) is not switched, the leakage can be judged to have occurred somewhere upstream with respect to the flow-path switch valve (8). When the pressure drop was substantial enough for indicating leakage when the flow-path switch valve (8) is switched after replacing the rotor seal of the flow-path switch valve (8), it can be judged that the rotor seal replacement was not done correctly.

[0007]

Application Example

Figure 2 illustrates an application example. A flow-path switch valve (8) is installed on the flow path (22) for feeding the mobile phase (4) to the column (20) by the feed pump (2). By switching the flow-path switch valve (8) of the autoinjector, the sample is introduced into the mobile-phase flow path (22). A detector (24) is installed downstream from the column (20), and the mobile phase is discharged through the detector (24).

[0008]

In the autoinjector, the flow path is switched by rotation of the flow-path switch valve (8) by the motor (26). The autoinjector control part (18) consists of a motor driver part (10a) controlled by the switch control part (10) for control of flow-path switching, A/D converter (30) for A/D conversion of the output of pressure sensor (6) in the feed pump, and a CPU (32) for control of not only activation of sample introduction by switching the flow path by the flow-path switch valve (8), but also leakage detection due to monitoring by the pressure sensor (6), and specifying the leakage site in relation to flow-path switching by the motor driver part (10a). The pressure monitor (12) leakage judgment part (14) in Figure 1 is realized by CPU (32) in Figure 2.

[0009]

Next, the operation of leakage detection and specifying the leak site in this example is explained with Figures 3 and 4. Figure 3 shows the operation for leakage detection in ordinary analysis. At the onset of analysis, CPU (32) conducts the input of pressure data from the output of pressure sensor (6) via A/D converter (30). In the absence of a drop in excess of a designated value, the pressure is considered normal, and the operation is continued. If the pressure drop is more than the designated value, leakage is judged. When leakage is judged, rotation of the flow-path switch valve (8) is checked by the output of motor driver (10a). If rotation of the flow-path

switch valve (8) is underway, the leakage site is judged to be in the injector part (flow-path switch valve (8)). If rotation of the flow-path switch valve (8) is not in operation, leakage is judged to be upstream from the flow-path switch valve (8). When leakage occurs, a warning is issued, and if this occurred before sample injection, the analytical operation is stopped.
[0010]

Figure 4 shows the leakage checking operation with replacement of the rotor seal of the flow-path switch valve (8). For this operation, as shown in Figure 2, a stop joint (40) is installed in the injector outlet pipeline. After replacement of the rotor seal of the flow-path switch valve (8), to check the working order of the rotor seal, the flow-path switch valve (8) is switched, the stop joint (40) in the injector outlet pipeline is closed to close the outlet of the flow-path switch valve (8), a designated pressure is applied in the injector flow path, and the output of the pressure sensor (6) is input to the CPU (32) via the A/D converter (30). If the rotor seal is correctly replaced, any pressure drop would not exceed the designated value. However, if the pressure drop exceeds the designated value, either the rotor seal is not mounted correctly or the rotor seal is defective, and a correct exchange is instructed. If the pressure drop does not exceed the designated value, the rotor-seal exchange data and pressure variation are memorized inside the liquid chromatograph to alert the next exchange.
[0011]

Effects of the invention

According to the present invention, utilizing a conventional pressure sensor of a liquid pump and incorporating a pressure monitor and leakage judgment part in the autoinjector, without adding new parts, any abnormality in sample injection and correct rotor-seal exchange can be checked automatically.

Brief explanation of the figures

Figure 1 is a block diagram illustrating the present invention. Figure 2 is a block diagram illustrating an example of the present invention. Figure 3 is a flow chart illustrating a normal analysis operation. Figure 4 is a flow chart illustrating the checking operation of rotor seal exchange as another operation example.

Explanation of symbols

2 liquid feed pump
4 mobile phase solvent
6 pressure sensor
8 flow-path switch valve
10 switch control part
10a motor driver part
12 pressure monitor part

switch valve (8) is underway, the leakage site is judged to be in the injector part (flow-path switch valve (8)). If rotation of the flow-path switch valve (8) is not in operation, leakage is judged to be upstream from the flow-path switch valve (8). When leakage occurs, a warning is issued, and if this occurred before sample injection, the analytical operation is stopped.
[0010]

Figure 4 shows the leakage checking operation with replacement of the rotor seal of the flow-path switch valve (8). For this operation, as shown in Figure 2, a stop joint (40) is installed in the injector outlet pipeline. After replacement of the rotor seal of the flow-path switch valve (8), to check the working order of the rotor seal, the flow-path switch valve (8) is switched, the stop joint (40) in the injector outlet pipeline is closed to close the outlet of the flow-path switch valve (8), a designated pressure is applied in the injector flow path, and the output of the pressure sensor (6) is input to the CPU (32) via the A/D converter (30). If the rotor seal is correctly replaced, any pressure drop would not exceed the designated value. However, if the pressure drop exceeds the designated value, either the rotor seal is not mounted correctly or the rotor seal is defective, and a correct exchange is instructed. If the pressure drop does not exceed the designated value, the rotor-seal exchange data and pressure variation are memorized inside the liquid chromatograph to alert the next exchange.
[0011]

Effects of the invention

According to the present invention, utilizing a conventional pressure sensor of a liquid pump and incorporating a pressure monitor and leakage judgment part in the autoinjector, without adding new parts, any abnormality in sample injection and correct rotor-seal exchange can be checked automatically.

Brief explanation of the figures

Figure 1 is a block diagram illustrating the present invention. Figure 2 is a block diagram illustrating an example of the present invention. Figure 3 is a flow chart illustrating a normal analysis operation. Figure 4 is a flow chart illustrating the checking operation of rotor seal exchange as another operation example.

Explanation of symbols

2 liquid feed pump
4 mobile phase solvent
6 pressure sensor
8 flow-path switch valve
10 switch control part
10a motor driver part
12 pressure monitor part

14 leakage judgment part
20 column
32 CPU

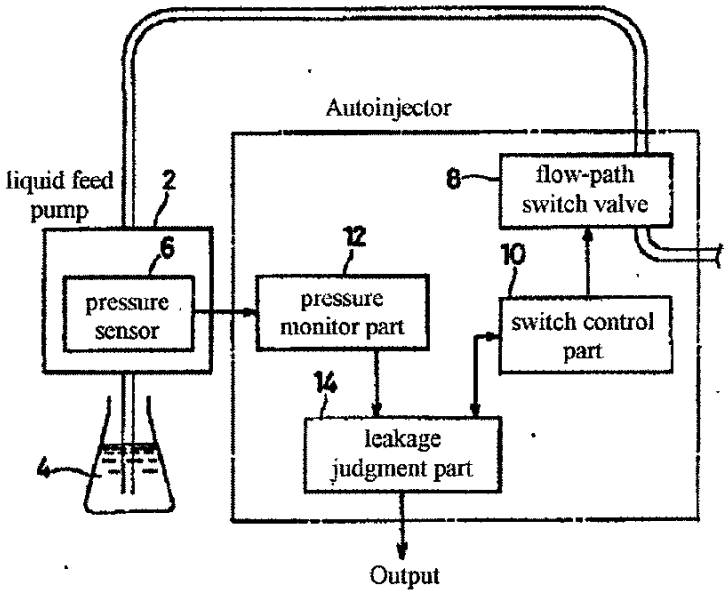


Figure 1

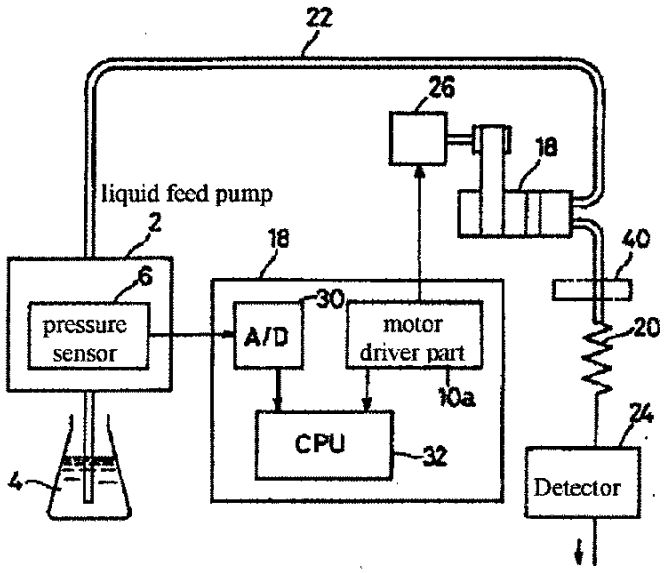


Figure 2

14 leakage judgment part
20 column
32 CPU

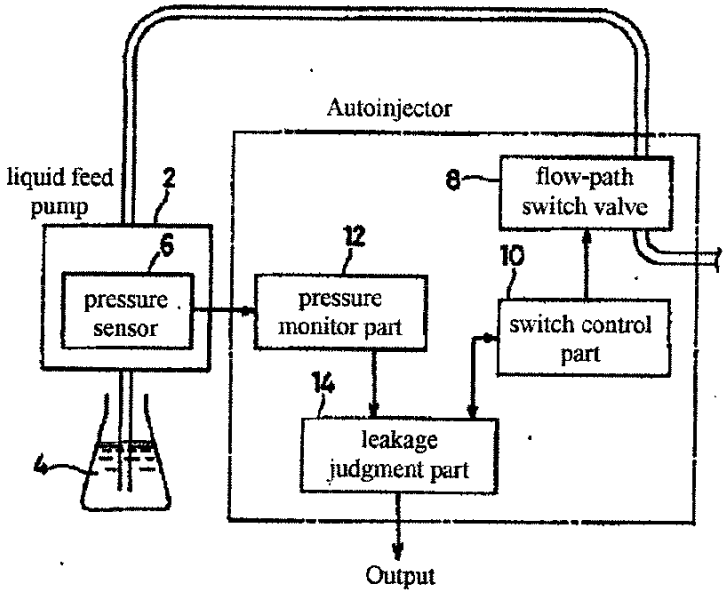


Figure 1

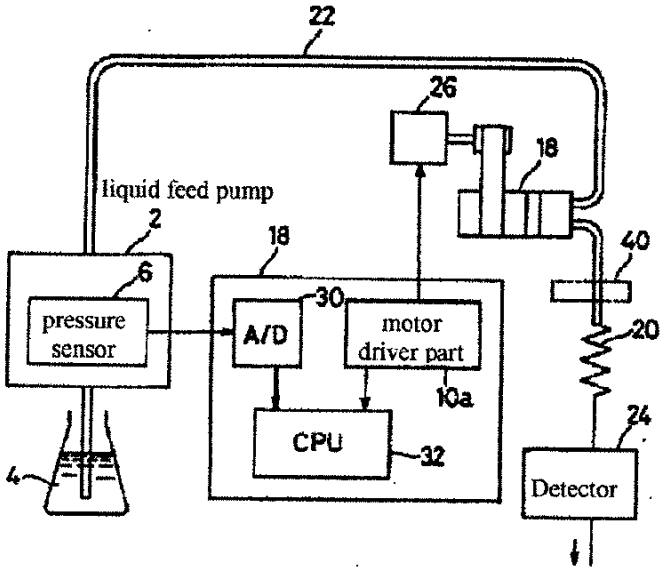


Figure 2

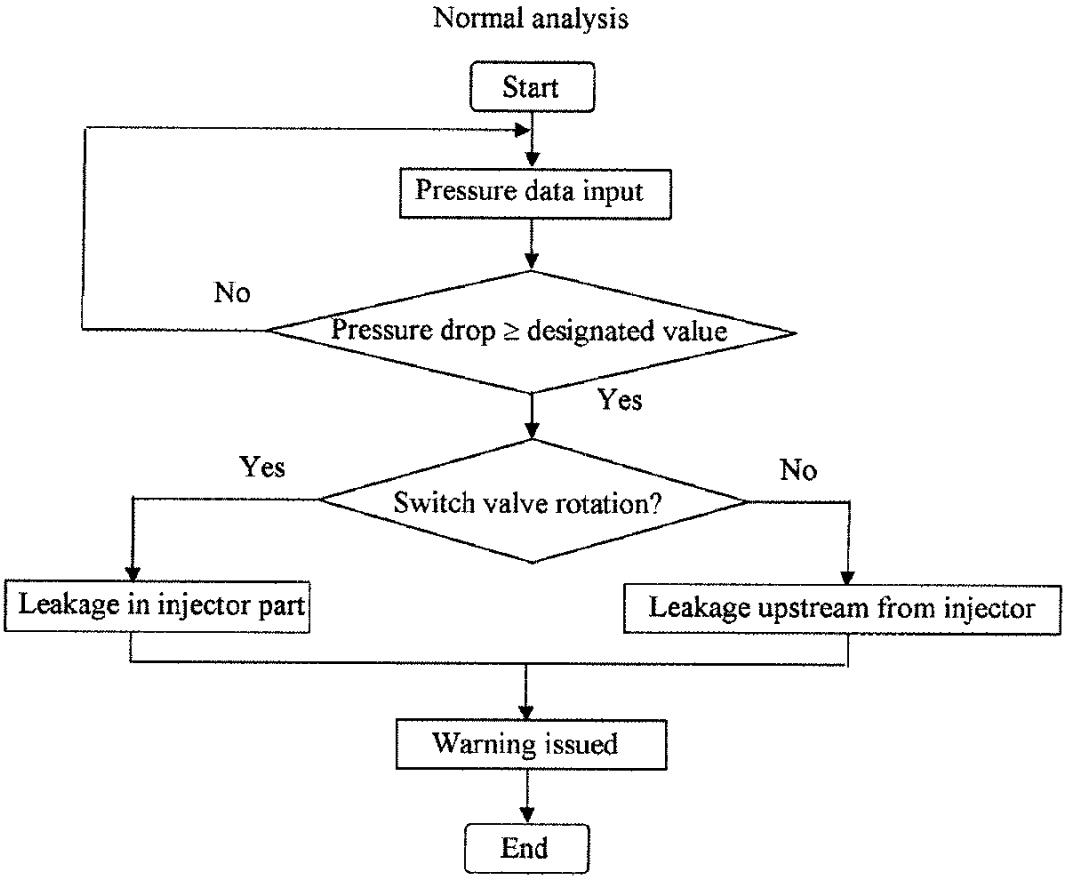

Normal analysis
Start
Pressure data input
No
Pressure drop ≥ designated value
Yes
Yes
Switch valve rotation?
No
Leakage in injector part
Leakage upstream from injector
Warning issued
End

Figure 3

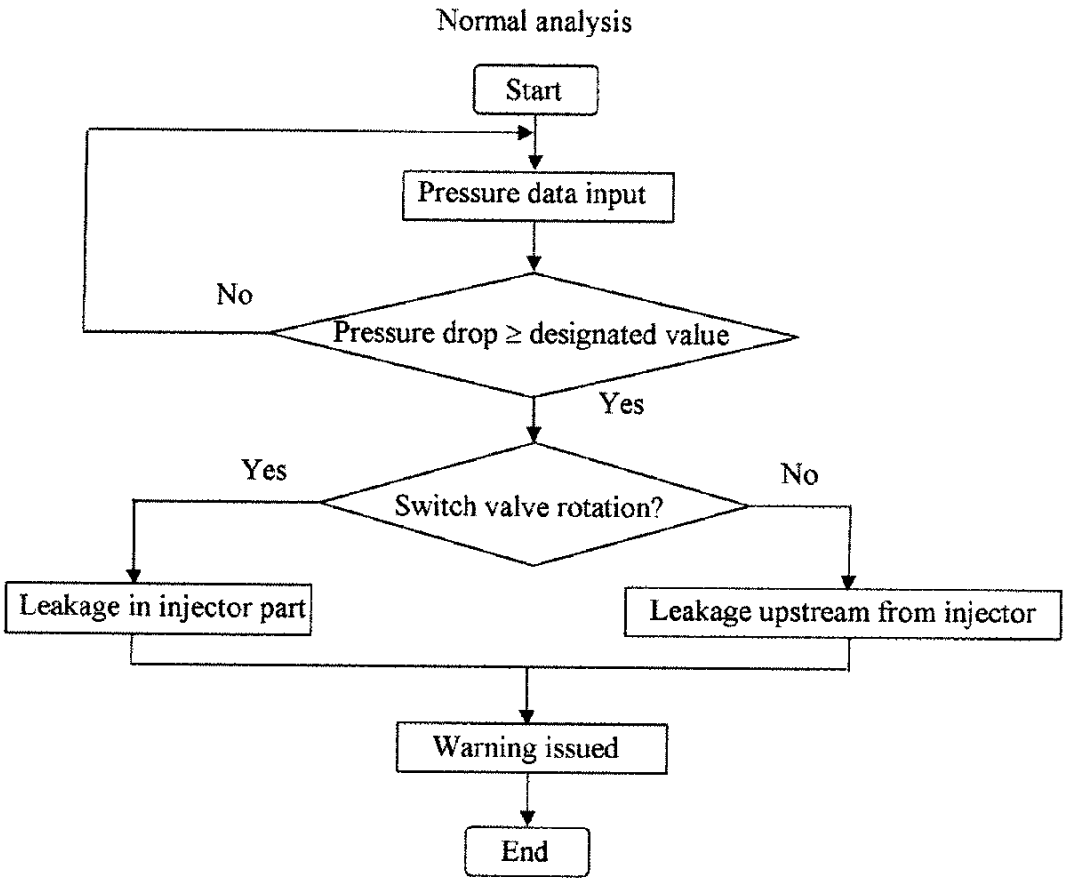

Normal analysis
Start
Pressure data input
No
Pressure drop ≥ designated value
Yes
Yes
Switch valve rotation?
No
Leakage in injector part
Leakage upstream from injector
Warning issued
End

Figure 3

With rotor seal exchange

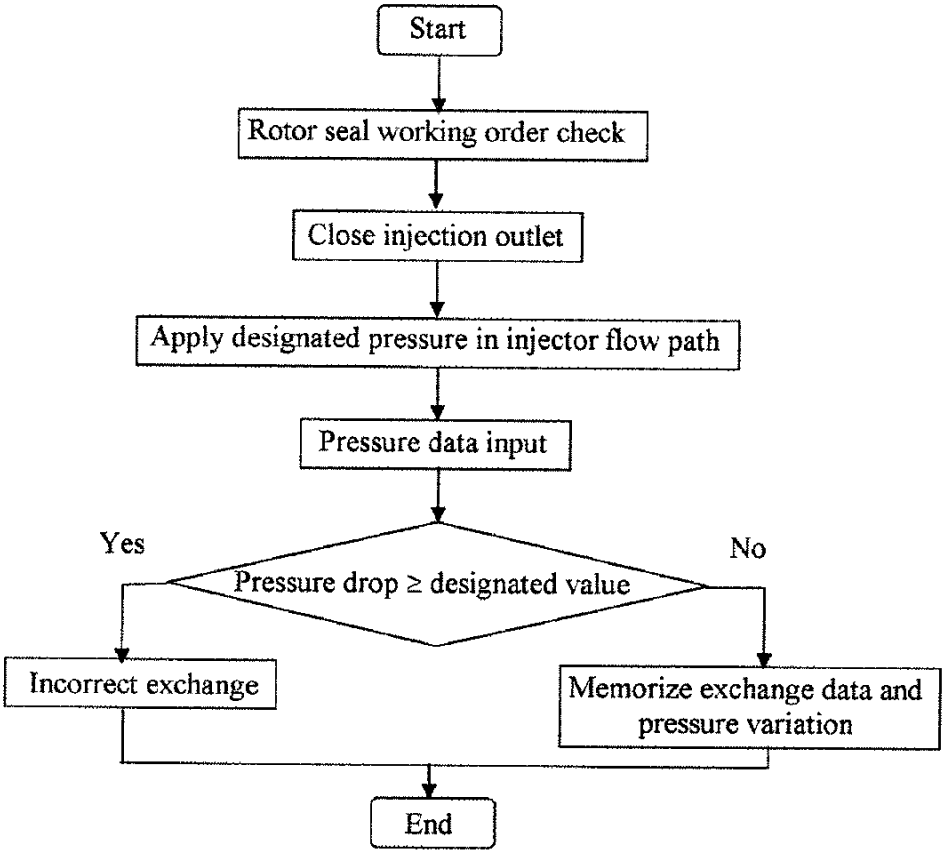


Figure 4

With rotor seal exchange

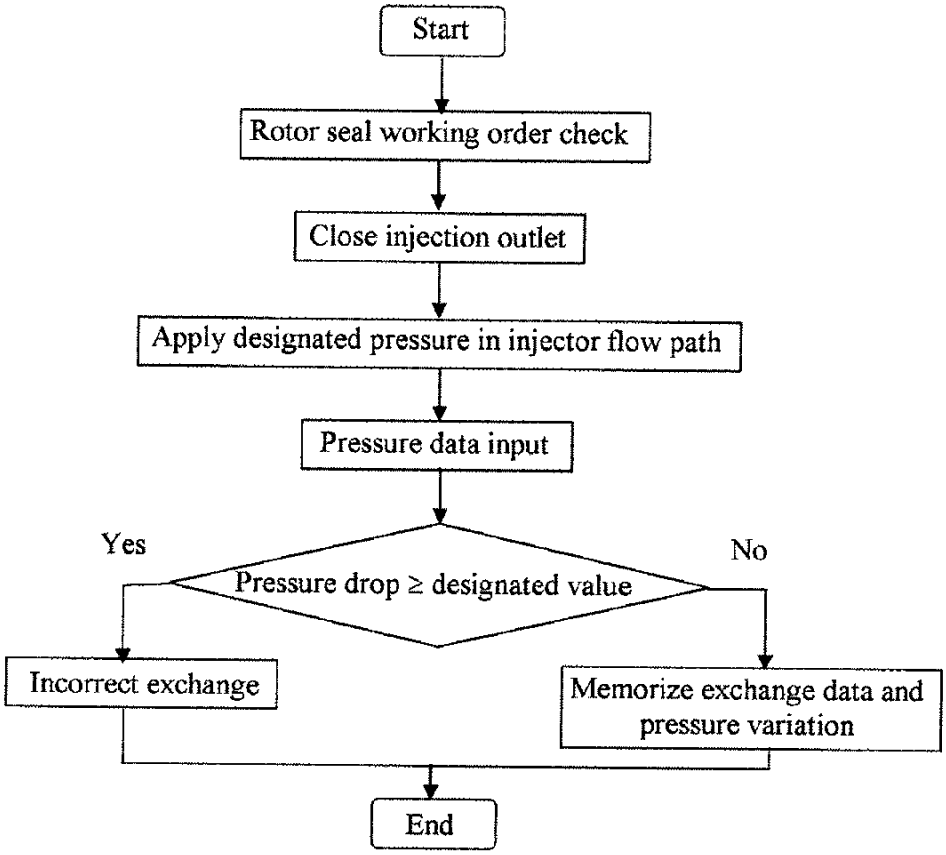


Figure 4